

Rapid increase in colorectal cancer rates in urban Shanghai, 1972–97, in relation to dietary changes

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Background In urban Shanghai, the largest industrial and commercial city in China, the age-adjusted (to world standard) incidence rates for colorectal cancer increased from 14.8 to 24.1 per 10⁵ man-years and from 11.7 to 20.7 per 10⁵ woman-years between 1972–73 and 1996–97. These changes were even more pronounced for colon cancer. The reasons for the rapid increases in cancer rates are not fully understood, but may involve dietary habits that have changed substantially over the past two decades.

Methods Based on incidence data on 37000 colorectal cancers from 1972–1997 and dietary information during the past 20 years, an ecologic correlation analysis was performed.

Results Available data indicate that per capita food consumption in Shanghai of vegetable oil, poultry, eggs, and pork rose rapidly during the period 1978–97, whereas consumption of seafood, grain, and fresh vegetables changed little or showed little consistent trends. Statistically significant positive associations were observed between colon cancer rates and per capita consumption of vegetable oil, poultry, fresh eggs and pork.

Discussion These findings suggest that increases in dietary fat and certain protein consumption may play a role in the rising colon cancer rates in Shanghai.

Keywords Colorectal cancer, trends, dietary factors.

Introduction

Colorectal cancer is the second leading cause of cancer death in the United States (1) and the fourth most common cause of cancer death in the world (2). Although the incidence and mortality rates for colorectal cancer are relatively low in the developing world, the rates have been rising in many low-risk countries over the past two decades (2–5). In urban Shanghai, the largest industrial and commercial city in China, the incidence rates for colorectal cancer have been increasing rapidly (6). The determinants of colorectal cancer in Shanghai are not fully understood. Environmental factors, particularly changes in diet and other aspects of lifestyle, may contribute to the rapidly rising rates of this cancer. To provide more data for suggesting dietary hypotheses, we analyzed updated trends in incidence rates of colorectal cancer and their association with per capita consumption of rice (grain), vegetable oil, pork, poultry, fresh eggs, seafood (including fish), and fresh vegetables in Shanghai from 1978 to 1997.

Materials and methods

Incidence data on colorectal cancer from 1972 to 1997 were obtained from the population-based Shanghai

Cancer Registry, a member of the International Association of Cancer Registries. Data sources and methods are described in detail elsewhere (6,7). In brief, about 150 hospitals that cover about 7 million people in urban Shanghai have been obliged to notify the Cancer Registry of all newly diagnosed cancer cases since 1972. Diagnostic information on cancer is coded and classified according to the International Classification of Diseases and classified for this analysis according to first three digits (8). Age-standardized rates per 100 000 person-years for colorectal cancer were estimated by the direct age-standardization method using the world standard population (6) for the periods from 1972–73 to 1996–97. Information on food consumption and economics was obtained from an official data resource of Shanghai Municipal Government, the Shanghai Statistical Yearbook 1998 (9), which contains comprehensive statistics on social and economic development in Shanghai since China adopted its reform policy in 1978. The yearbook provided annual retail sales of main consumer foods for: grain (rice), vegetable oil, pork, poultry, fresh eggs, seafood, and vegetables. To adjust for population changes during this period, we estimated per

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capita consumption per year by dividing total retail sales for each food item in a given year by the population in that same year. Per capita food consumption rates were calculated based on two-year averages 1978–79 through 1996–97. Figures portraying the temporal trends were prepared using semi-log scales and vertical-to-horizontal axis ratios of one log-cycle = 40 years such that a slope of 10 degrees represents a change of 1% per year, allowing visual comparison of the rates of change across figures (10). The associations between food consumption variables and incidence of colon and rectal cancers over the period of 1978 through 1997 were measured using Pearson correlation coefficients (r) (SAS Release 6.12, SAS Institute, Inc) because dietary data were only available in this period (data points = 10). All P values were two-sided and were considered to be statistically significant at the .05 level.

Results

From 1972 to 1997, 19 050 cases of colorectal cancer were diagnosed in urban Shanghai among men and 18 230 cases were diagnosed among women. Figure 1 shows the trends in rates of colon and rectal cancers. Colon cancer incidence rates increased 3.7% per year, from 5.80 in 1972–73 to $13.74/10^5$ in 1996–97 for men and 5.35 to $12.78/10^5$ for women. Rates of rectal cancer also rose, although considerably less rapidly (1% per year or less), from 9.02 to $10.33/10^5$ for men and from 6.37 to $7.94/10^5$ for women. From 1978–79 to 1996–97, per capita consumption of vegetable oil and poultry more than tripled (from 4.3 to 14.7 kg and from 1.6 to 8.0 kg, respectively) (Figure 2). Fresh egg consumption also rose rapidly through the 1980s, but the increases

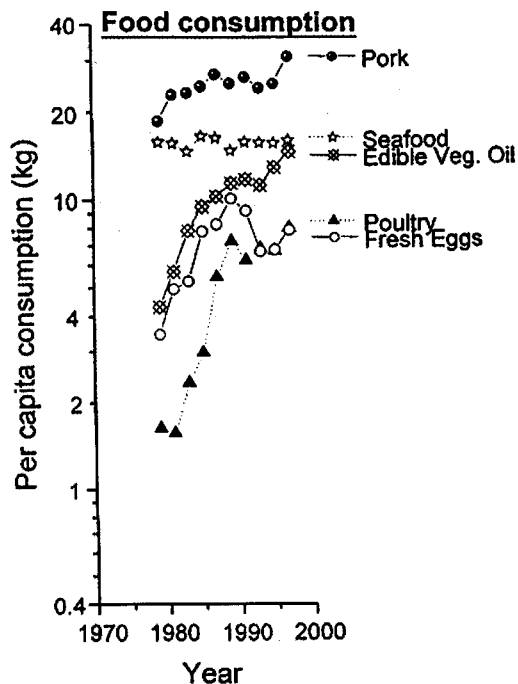


Fig. 2 Per capita food consumption of pork, seafood, edible vegetable oil, poultry, and fresh eggs in Shanghai, 1978–79 to 1996–97.

did not persist into the 1990s. Pork consumption rose 66% over the 20-year time period, due especially to increases at the earliest and latest intervals, with relatively stable rates during the intervening years. Consumption of seafood did not change significantly during this period (from 15.8 kg in 1978–79 to 16.1 kg in 1996–97). Fresh vegetable consumption also did not

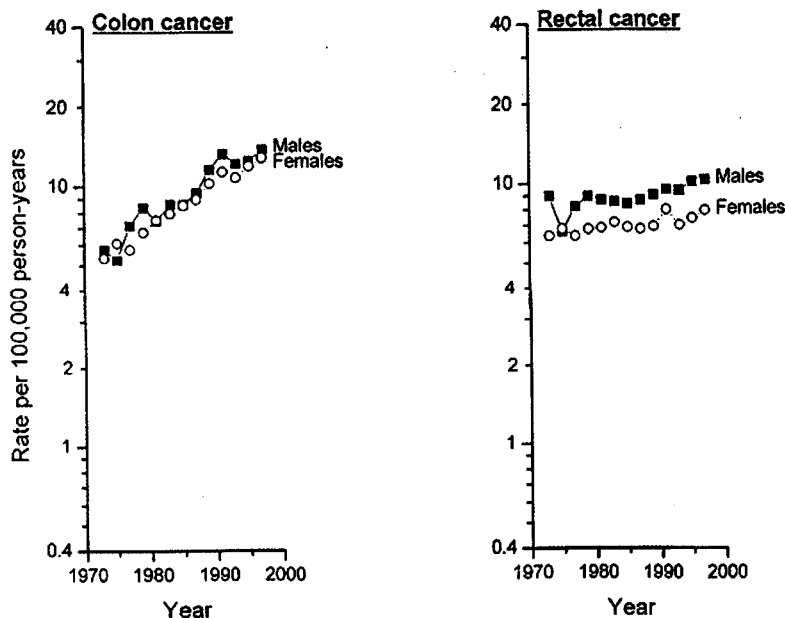


Fig. 1 Age-adjusted incidence rates (world standard) in urban Shanghai for colon and rectal cancer, 1972–73 to 1996–97.

change remarkably during this period, from 98.4 kg per capita in 1978–79 to 110.4 kg in 1996–97 (data not shown). Rice consumption increased from 153.1 kg per capita in 1978–79 to 237.4 kg (+55%) in 1992–93, and then rapidly decreased to 139.9 kg (–41%) in 1996–97.

Statistically significant positive associations were observed between colon cancer incidence rates and per capita consumption of vegetable oil ($r=0.89$ for men and 0.96 for women, $p<0.01$), poultry ($r=0.93$ for both men and women, $p<0.01$), pork ($r=0.68$ for men and 0.79 for women, $p<0.01$) and fresh eggs (0.63 for women, $p=0.05$); the association with fresh egg consumption among males was marginally significant ($r=0.61$, $p=0.06$). For rectal cancer, similar but weaker associations were observed for vegetable oil, pork, poultry, and fresh eggs. The associations were not statistically significant between either colon cancer or rectal cancer and per capita consumption of rice, vegetables, or seafood.

Discussion

Based on nearly 37 000 incident colorectal cancers diagnosed during 26 years and dietary information during 20 years, this ecologic correlation analysis shows that the dramatically rising rates of colon cancer have been strongly associated with rising per capita consumption of dietary vegetable oil, poultry, pork, and fresh eggs in Shanghai. The dietary changes during this period reflect economic reforms and changes in Shanghai since 1978. Within the past 20 years, the gross domestic product (GDP) per capita increased from \$310 to \$3,400, and savings per capita increased from \$20 to \$2614 in Shanghai (9). In the early 1970s, rice constituted the main dietary component, and there was little consumption of oil or meat, due to supply shortage and cost. Because of increasing disposable income and adequate food supplies after economic reform was initiated, many people in Shanghai have gradually shifted from a traditional Chinese diet with high levels of consumption of rice and fiber, and low fat and meat consumption, to a more Western diet. Consequently, the per capita consumption of rice declined sharply within the 5 years from 1992 to 1997, whereas the consumption of vegetable oil, and to a lesser extent, pork and poultry, has continued to increase substantially. The positive secular trends in per capita consumption of dietary fat, pork, poultry, and eggs within this population suggest that dietary changes may have modulated the risk of colon cancer over a relatively short period, and thus may act in the late stages of carcinogenesis. The findings in our study are consistent with migrant and other temporal trend investigations, which showed a relatively short latency for rapid changes in colon cancer rates, suggesting colon cancer is determined mainly by environmental

factors (3,11). We found a weak association between rectal cancer and dietary changes in Shanghai, which suggests a different biological model in rectal cancer carcinogenesis (4). Vegetable consumption was not associated with risk of colorectal cancer in a recent prospective study in the United States (12). We also found no association between per capita vegetable or seafood consumption and colon cancer rates, suggesting that these dietary components have little impact on the rising colon cancer rates in Shanghai.

The Yearbook is an official statistical book published by the Shanghai Municipal Government. Information on population, labor force, living standards, prices, consumer goods, economics, trade, financial, agriculture, industry, transportation, and major food consumption in Shanghai was systematically collected by the Statistics Bureau of Shanghai.

Although international ecologic studies show that total and saturated dietary fat, and meat consumption are strongly correlated with the rates of colorectal cancer (11), results from eight cohort and 26 case-control studies in developed countries are inconsistent (3,11). The reasons for the failure to identify fat and meat consumption as risk factors in some case-control or cohort studies are not clear. In developed countries, dietary patterns tend to be relatively homogeneous, with high levels of consumption of meat, dairy products, and total fat, particularly saturated fat. Because of this narrow range of exposure, it may be difficult to detect dietary risk factors for colorectal cancer at the individual level, even though they may contribute to the high incidence rates for this cancer.

Some limitations of this study should be mentioned. Because we do not have cooking practice data, we are not able to distinguish between the effects of meat and saturated/animal fat. In addition, we cannot evaluate the effects of multiple exposures, nor can we separate estimates of risk associated with fat intake from those due to high caloric intake. The present correlation study does not allow us to examine the association at the individual level and to examine confounding factors that might account for the associations observed. In particular, we lack individual-level information on other variables that may be associated with colorectal cancer risk (3,11), such as physical activity, and consumption of alcohol, sugar, and fiber in this population. Early detection is unlikely to account for the rising colorectal cancer rates because screening for this malignancy is not generally available in Shanghai (6,7), and our study showed that the trends in rectal cancer rates were modest.

In the future, an analytic study of individual subjects in Shanghai might shed light on the role of diet, cooking practices, and the timing of dietary exposures in the

etiology of colorectal cancer. Because of the broad range of income levels (more than a 10-fold annual income difference per capita) and the increasing influence of westernization, people in Shanghai are likely to vary greatly in their dietary habits and the times at which their diets may have changed.

In conclusion, strong associations between colon cancer rates and intake of vegetable oil, poultry, eggs, and pork over time suggest that the adoption of Western dietary practices over the past 20 years may have contributed to the sharp rise in colon cancer rates in Shanghai.

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